In one respect the observations are incomplete, and need to be supplemented at some future time. Within the lighthouse the source of light is surrounded by an apparatus which gathers together the light sent forth in all directions, excepting a small angle above and below. Thus, the intensity of the light sent in a sloping direction upwards and downwards is of as great importance as that of the light sent forth in the horizontal plane. But only the latter has hitherto been measured in the photometric gallery. According to M. Allard the electric arc produced by an alternate current sends out horizontally an amount of light which is 11 per cent. greater than the average amount sent in all directions. With a continuous current the strongest light is thrown on the side opposite to the positive carbon; but it happens that with an arc light of this description horizontal measurement gives the average value. Probably Mr. Wigham's wide cluster of gas jets sends forth less light horizontally, owing to the imperfect transparency of one flame to the light of another, than it sends in an upward direction; and the same may be the case with the concentric gas-burners and oil lamps. Mirrors might hereafter be arranged within the photometric gallery, which would serve for making these measurements.

To determine accurately at a distance the power of the various lights exhibited was an essential preliminary to calculating the range of any of the lights in hazy weather. And although this power is approximately calculable, the power and dimensions of each flame, and the structure of each lens being known, it was of great interest to make actual measurements of the intensity of the light at two different points, and in different states of the atmosphere. I am not aware that such measurements had ever before been attempted. Owing to the novelty of the photometric problem, and to some extent of the methods employed, it was highly important to have some means of testing how far the results were trustworthy. Such means were furnished by the multiform system of Mr. Wigham. At any distance, and in any state of the atmosphere, the illumination produced by a combination of two or more similar lamps and lenses is so many times as great as the illumination produced by a single lamp and lens of the same kind. Thus, among the lights to be measured were several whose relative power was known beforehand. If testings of single and multiform lights, made in succession while the degree of clearness of the air was unchanged, gave values varying approximately as the number of lights, an equal degree of exactness may be ascribed to the testings of other lights and lenses.

On July 12, the weather being "clear, calm, overcast," the light from the single, biform, triform, and quadriform 108-jet burners, showing through Mew Island lenses, was measured at hut I. The results in thousands of candles were 50, 98, 168, and 214. Three testings intervened between the second and third, and probably the air had become a little clearer, but the numbers are not far from the ratio 1, 2, 3, 4. Three days later the same single, triform, and quadriform combinations were tested one after the other, also at hut I. The values found are 48, 145, and 186. Similar testings were made on July 23, on a clearer night, of all four combinations; their power was found to be 58, 112, 171, and 220 thousands of candles. Probable values in the ratio of 1, 2, 3, 4, are 56, 112, 168, and 224. On the same night the value found for a single six-wick oil lamp behind an Eddystone lens was 56,000 candles, and for three such lamps behind three such lenses 168,000 candles. On November 1, in thick haze, the value found at the nearer hut for "I. Gas, 108, M.," was 25,500 candles, and for "IV. Gas, 108, M.," 102,000. The results obtained at hut II., with a wholly different photometer, are confirmed in the same manner. For example, on February 7, consecutive testings on a misty night of "single" and "quadriform gas" gave in thousands of candles the numbers 26 and 101. On March 20, on a very clear night, the values found for the same two lights were 63 and 252.

In looking over the tables of the photometric record, and comparing the figures standing against combinations of equal numbers of oil lamps behind Eddystone lenses, and of the larger gas-burners behind Mew Island lenses, in all weathers in which the lights were measurable, the eye is struck by the similarity of the numbers. The rival systems are nearly equal; there is little to choose between them. Still less difference, as has been pointed out, was discernible on looking, as we did night after night, at the lights themselves. Other considerations than that of visibility in either clear or hazy whether, must decide which, if either, of the two systems is to be generally adopted for lighting our coasts. By multiplying burners and lenses, and by enlarging the size of the lenses, more powerful lights still may be produced, if it is thought desirable, with either illuminant.

But the most prominent fact on the face of the photometric record is the immense superiority of the electric light. The conclusion forces itself upon the reader of these tables that if greater power is needed, it is to be found, not by magnifying lenses or multiplying combinations of gas or oil burners, but by substituting the light of the electric arc.

The Trinity House Committee report that the electric light in clear weather is certainly not popular with sailors, chiefly on account of its dazzling effect at short ranges. But at ranges exceeding two or three miles, "hyper-radiant," or even multiform lenses, are not visibly larger than such a lens as is suitable to the electric arc; and at such ranges the "dazzling effect" is simply that due to the power of the light. If a double quadriform were as powerful it would dazzle as much. Also the use of a powerful electric arc in clear weather may be avoided. It would not be difficult to arrange for the use of a small electric arc during clear weather, and the quick substitution of a powerful arc light when the weather became hazy. I would venture to suggest that the singular circumstance which led or contributed to the removal of the electric light at Dungeness, that a vessel went ashore near the lighthouse, may have been due, not to the dazzling effect of the light, but rather to the diminution of brightness as the approaching vessel passed within and beneath the range of the light. With the condensed and sharply-defined beam of the electric light, it may perhaps be desirable to devote some part of the optical apparatus to spreading a portion of the light over the space intervening between the coast and the point, a mile or two away, at which the principal beam first strikes the sea. If this is done, the light at short ranges might be made sufficient, but not too dazzling; and for longer ranges there seems to be no reason why the powerful beam produced by the electric arc behind one of the Mew Island lenses should not be employed. This beam had a divergence of about 1°. Even from the high level of the South Foreland lights, if the axis of such a beam were so inclined that only about $\frac{1}{6}$ of the light passed over the horizon, the full light would extend to within about three miles of the shore. Since the apparent brightness of every light must vary with the state of the atmosphere, as well as with the distance of the light, and as the angle subtended, even by a multiform light, at a few miles distance is very small, it cannot be possible by the appearance of a light without other data to judge of its distance. The electric light is not singular in this respect.

(To be continued.)

THE LUMBAR CURVE IN MAN AND APES

We are indebted to Prof. Cunningham, of Trinity College, Dublin, for a well-illustrated and exhaustive memoir on the subject of the lumbar curve in man and apes. This memoir has been printed by the Royal Irish Academy as one of the Cunningham Memoirs, and is illustrated by thirteen plates, several of which are large folding ones, and two of which are large coloured drawings of the two surfaces of a mesial section of a male chimpanzee; these are life-size, and are the first accurate representations of the topographical anatomy of this anthropomorphic ape we have seen.

The structural differences between man and the anthropoid apes are no doubt in a great measure due to the assumption by man of an erect attitude, and to his having from an early period of his life dispensed with the use of his anterior extremities as organs of locomotion. The vertebral column of man might be expected to exhibit in a marked degree differences distinguishing it from other animals, and that more or less deep convexity forwards in the region of the loins has been considered by some not only as a marked character of the human spine but even as peculiar to humanity; other anatomists have denied that this is so, and consider that man and certain of the man-like apes have it in common. In this memoir Prof. Cunningham seems to minimise the importance of the lumbar curve as a distinctive character of any special group. Not only the higher, but also the majority of the lower apes, possess this curve; and, under

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certain conditions, even some quadrupeds show clear traces of it. In the course of his investigations, Prof. Cunningham has brought many new and interesting facts and phenomena to light. Thus in man and the chimpanzee the quality of this lumbar curve is identical; the only differences are its extent and its development. And then among the members of the human race this curve does not appear to be equally prominent; upon some—as the Australian, the Negro, and the Andaman Islander—the curve is by no means so well marked as it is in the European. Not that the absolute degree of curvature is less in these races, but whereas in the European the bodies of the vertebræ are more or less moulded in adaptation to the curve, in the lower races there is to be found no trace of this. With this subject the first part of this memoir is taken up, and the adaptation of the vertebral bodies with reference to the lumbar curve is considered in a first section. The method of making the measurements, and the results derived from them, are given, and special points in connection with the European and several of the lower races (Australian, Tasmanian, Andaman, Negro, and Bushman) are given. Then follow details of the indices of the lumbar vertebræ in the four man-like apes, as well as in nine of the lower apes. The statement that this curve is more marked in the female than in the male is strongly supported by the evidence adduced in this memoir, and it would seem that the vertebral bodies of the female are moulded more in adaptation to the curve than those of the male.

The second section of this part of the memoir treats of the entire lumbar curve as found in man and the apes. The difficulties in the way of securing accurate curvatures of the living spine seem to be insuperable. Parow, who worked hard on this subject, has signally failed; hence the standard of comparison must be sought for in the dead, and the details of how this has been done are given at some length. Racial differences are next discussed, and the development of the spinal curve is treated at great length, with some excellent illustrations. The condition of the lumbar column in the anthropoid apes is next considered. It was, as we have seen, thought that the lumbar curvature did not exist save in man. Goodsir is positive about it. Sir W. Turner at one time was equally so. Sir Richard Owen denies its presence in the gorilla and orang-utan. Huxley was among the first to assert its existence. Broca and Topinard followed. As to the facts to be seen by frozen sections, Cunningham has not succeeded in getting fresh material for the gorilla; but in the case of the chimpanzee the curve differs but little from that in man. In the orang it is feeble, resembling that in man in some respects, and in others differing from that in the chimpanzee. In a gibbon (*Hylobates agilis*) it stands intermediate between the chimpanzee and orang. In some of the monkeys it is also to be found, and even in some quadrupeds.

In a second part of his memoir, Prof. Cunningham, taking advantage of the same anatomical method which enabled him to make such interesting discoveries as to the extent of the curves of the vertebral column, viz. by sections through recently frozen bodies, has been able to advance our knowledge of the topographical anatomy of the orang, chimpanzee, and gibbon, very considerably. Certain relations of distinct morphological importance cannot by any other method be with accuracy ascertained. The question of how far the cerebrum in the anthropoid apes projects backwards in relation to the upper surface of the cerebellum, was at one time a burning question, and, although fairly set at rest, cannot be said to have been unmistakably demonstrated until now; when the whole of the parts were frozen in their places, sections were made, and we have the results in this memoir amply corroborating previous inductions. Sections of the brain *in situ* in the adult male and newly-born child, in the male and female chimpanzee, female orang, and gibbon, are all figured. Other points in the anatomy of the brain, as the condition of the corpus callosum, and of the hippocampus minor are also alluded to, and a few further details as to other visceral anatomy are given.

The memoir forms a quarto volume of some 150 pages, the typography of which is extremely creditable. The woodcut illustrations and plates are excellent, and the publication of this treatise as a Cunningham Memoir marks the appreciation of its value by the Council of the Royal Irish Academy, as the series of its publication—known as the Cunningham Memoirs, because the expenses thereof are defrayed out of the funds left by a Mr. Cunningham—is reserved only for works which the Council believe contribute some new facts to science.

SCIENTIFIC SERIALS

Bulletin de l'Académie Royale de Belgique, August.—Note on the eruptive rocks of the islands of Marion, Prince Edward, Macdonald, and Heard, by A. F. Renard. These insular groups, which stand on the great submarine plateau in the southern regions of the Indian Ocean, are shown to be entirely volcanic, in no way connected either with the Madagascar group or with the lands of the South Polar seas. Marion and Prince Edward, which were visited and partly explored by Mr. Buchanan, of the *Challenger* Expedition, consist of old plutonic formations, such as feldspar basalts and much more recent black and other lavas. Heard, discovered in 1853 by the American captain Heard and also visited by the *Challenger*, is largely covered with a black volcanic sand formed of grains of magnetite and augite. Elsewhere occur more recent lava formations, which show no trace of the erosive action exercised by the sands on the older rocks. All the specimens collected here belong mainly to the group of feldspar basalts.—On the presence in Belgium of *Bothriocephalus latus*, Bremser, by Edouard van Beneden. A few recent instances are recorded of the presence in Belgium of this human parasite, which is common enough in Holland.—Experimental researches on the influence of magnetism on the phenomenon of polarisation in dielectrics, by Edmond van Aubel. In this second communication the author gives the result of fresh experiments, showing how, by means of a specially-constructed electro-magnet, the electric field which interfered with previous researches may be completely eliminated, while preserving an intense magnetic field. The electro-magnet here described may also be used in ordinary physical experiments, wherever it is necessary to ascertain whether the phenomena observed with the Ruhmkorff and other electro-magnets are due to magnetism and not to the electric field or to the heat of the current traversing the bobbins.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, November 2.—M. Jurien de la Gravière, President, in the chair.—Fresh communication on rabies, by M. Louis Pasteur. (For summary of this report, see p. 30).—Note on the unequal flow of gases, by M. Haton de la Goupillière. Having, in previous papers, given a complete analytical solution of the various problems connected with this subject, the author here determines the true character of his formulas in their relation to experimental applications.—Remarks on M. Fontaine's report concerning his experiments on the transport of power by electricity, by M. Marcel Deprez. It is pointed out that M. Fontaine's method, which replaces the generator and receiver by a series of machines coupled together in sufficient number to produce the desired effect, so far from being based on any new principle, is the same as that proposed by all electricians who have sought to obtain high tensions without having recourse to the construction of the special machines first suggested by the author. The means employed by M. Fontaine to control simultaneously the four series of generators is also stated greatly to resemble that described in a patent taken out on April 28, 1885, by M. Deprez.—Experimental researches connected with the cerebral functions, by M. Brown-Séquard. These researches have been undertaken in order to show how varied and numerous are the purely dynamic effects proceeding from influences exercised on the encephalon by the sensitive nerves, and on the motor nerves by the nervous centres. Experiments carried on for seven or eight years lead to the general conclusion that all the motor nerves, and nearly all the excitable parts of the nervous centres, may have their excitability greatly modified, even under the influence of remote and slight irritations of the greater part of the nervous system.—On the atomic weight of the oxide of gadolinium, by M. A. E. Nordenskjöld. This compound is not a simple oxide, but consists of the three closely-related oxides of yttrium, erbium, and ytterbium, all with very different atomic weights. Nevertheless, even when derived from quite different minerals occurring in localities far removed from each other, it is here shown to possess a constant atomic weight. On the other hand, this substance is not a true chemical combination, but an isomorphous mixture, thus presenting a new phenomenon in chemistry and mineralogy. It is the only known instance of three isomorphous substances of the class which must still be regarded as

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